

ANSWERS: Uses of metals

1. Aluminium is a low density metal with a high strength to mass ratio. As the can is lightweight, it can be carried around by the average person, even when filled with fluid, with relative ease / transported in bulk more easily.

Aluminium is malleable so is easily shaped into a soft drink can.

Aluminium has high chemical reactivity but it forms an oxide coating on it that prevents further reaction, so does not react with the chemicals in the soft drink.

Any named metal with a relevant chemical OR physical property that makes it unsuitable. eg:

- Lead is too dense, so the cans would be too heavy to carry around easily or transport in bulk. It is also reactive, and would slowly react with the acid soft drink.
- Group 1 and 2 metals are too reactive with acid in soft drink.
- Gold, although unreactive, is too dense, so the cans would be too heavy to carry around easily or transport in bulk.
- Iron will react with the acid in the soft drink.

2. Aluminium

- Its low density makes it the first choice for long distance powerlines because it is cheaper to build structures to hold up powerlines despite:
 - Less (63% of) electrical conductivity of copper which means it will not be as efficient in its energy transfer.
 - Aluminium is corrosion-resistant due to oxide layer that is formed because of aluminium's reactivity with oxygen in the air so it will withstand the conditions of the outside.
 - Aluminium is more ductile than copper, so easier to draw into wires which is more efficient and useful for long distance wires.

Copper

- Excellent electrical conductor so cheaper alternative because little wasted electrical energy.
- Is denser (and thus expensive support structures needed to be used in comparison to aluminium).

- Also corrosion resistant so will not react with household substances and cause any problems.
- Has higher melting point than aluminium, so is less likely to melt and cause damage in household wiring.

3. Properties of aluminium:

- Aluminium is very malleable, and able to be shaped, without cracking, into cans or foil.
- Aluminium has low density. This gives aluminium its unique lightweight property which keeps costs low for transportation and packaging.
- Aluminium is easily recycled, using less energy than that originally used to extract it, so makes it a more sustainable metal than many others.
- Aluminium is also completely impermeable even when rolled into extremely thin foil, and also doesn't let the aroma or taste out of food packaging.
- Aluminium is non-toxic and odour-free, making it perfect for packaging.
- Aluminium foil acts as a barrier to moisture, preventing loss of moisture that may result in a less appealing texture of foods.
- Aluminium is a good conductor of heat which is important when wrapping food in it for cooking so heat energy can get through.
- Aluminium foil is a poor emitter and absorber of radiation, and a good reflector of radiation, so cold food wrapped in foil won't heat up that fast/ hot food won't cool down quickly.
- Aluminium has a relatively high melting point which is important when wrapping food in it for cooking as it doesn't melt.

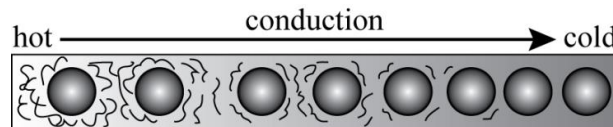
Why used when reactive:

Aluminium forms a very thin layer of aluminium oxide, Al_2O_3 . As this aluminium oxide is impervious to most chemicals, the aluminium does not undergo any reactions. The aluminium oxide acts as a protective layer, making the metal both durable and unreactive. It is ideal for using to package food and drink, despite the fact that aluminium is quite high on the activity series.

4. When part of a metal is heated, the (kinetic) energy of the electrons in that area increases. Since the electrons are delocalised and able to move freely, they can move quickly into the cooler parts of the metal and transfer their (kinetic) energy by colliding with other electrons. In this way, the heat travels from hotter to cooler parts of the metal.

OR

The amount of the vibration of the atoms and electrons of the metal near the heat source becomes relatively large because of the high temperature of their environment. The increase in the amount of vibration and the associated (kinetic) energy are passed along the metal from atom to atom during collisions between adjacent atoms. In this way, the region of rising temperature extends itself all along the length of the metal.



Uses of metals:

Eg copper used as a base on saucepans because it spreads heat evenly over the base of the pan.

Eg iron used in steel to make barbeque plates so heat is spread evenly and ensures even cooking of food.

Eg iron is used in radiators because it is able to conduct heat from oil / water and radiate it from the iron surface into a room. etc.

5. Silver is a non-reactive metal.

Iron is higher on the activity series and is more reactive than silver.

Both metals are malleable and strong, so both could be shaped into jewellery. Silver is shiny and attractive and therefore more pleasing to the eye than iron. Silver is suitable to use in piercings because it is chemically quite stable / non-reactive so unlikely to corrode on contact with slightly acidic skin or moisture found on skin or oxygen in the air.

Iron is more reactive and could rust. Iron does react with acids, water and oxygen in air. This could be a cause of infections to the body.

6. Aluminium is very malleable, and able to be shaped without cracking, into cans or foil. Aluminium has low density. This gives aluminium its unique lightweight property which keeps costs low for transportation and packaging. (of large numbers of cans or foil dishes or rolls.)

Aluminium forms a (very thin) oxide coating, Al_2O_3 , which forms a protective layer, making the metal very corrosion resistant and durable.

It is ideal for using in food and drink packaging. So despite the fact that aluminium is quite high on the activity series, it is unreactive due to its oxide

coating which prevents the metal from reacting with the food / drink / named substance(s).

Aluminium is easily recycled, using less energy than that originally used to extract it, so makes it a more sustainable metal than many others.

Aluminium is also completely impermeable; (even when rolled into extremely thin foil), and also doesn't let the aroma or taste out of food packaging, the metal is non-toxic and aroma-less itself too, making it perfect for packaging. Aluminium foil acts as a barrier to moisture, preventing loss of moisture that may result in a less appealing texture of foods.

Aluminium is a good conductor of heat which is important when wrapping food in it for cooking so heat energy can get through.

Aluminium foil is a poor emitter and absorber of radiation, and a good reflector of radiation, so cold food wrapped in foil won't heat up that fast / hot food wrapped in foil won't cool down quickly.

Aluminium has a relatively high melting point which is important when wrapping food in it for cooking so it doesn't melt.

7. Sodium is stored in oil because it is too reactive with oxygen (air), water and acid. It is also very soft. It is

malleable and can be shaped but it is too soft/weak to hold its shape.

Aluminium, although reactive, has an oxide layer because it has already reacted with oxygen. The oxide layer protects / masks reactivity / prevents further reaction with substance(s) eg water, oxygen, acids. It is now unreactive and it is hard enough as well as malleable to be shaped.

(Other chemical and physical properties may be relevant such as density.)

8. Relevant physical property of metals: malleable

Comparison of metals links to chemical property, eg: Copper is resistant to reaction with oxygen,

water or acid so will be long lasting. Iron is more reactive and would rust or react if in contact with oxygen or water. Iron would rust would weaken the roof or make holes in roof .

9. Malleable. (High) lustre / lustrous / shiny

Unreactive / Non-reactive (in oxygen / water / acid).

Malleable – able to shape : without breaking / into a suitable shape (eg *ring shaped*)

Lustre / shine – attractive to customers. Non-reactive in oxygen : won't react in air / corrode / tarnish.

Non-reactive in water : won't react in rain or dishwashing water or in the shower.

Non-reactive in acid : won't react with common substances such as lemon juice, vinegar, soft drinks.

10. window frames for houses unreactive (with air or water) / has protective oxide layer (must be linked to reactivity) / doesn't corrode / malleable / can be anodised (and coloured) overhead electrical power cables conducts electricity / ductile / lightweight or low density (**NOT light**) / unreactive (with air or water) / has protective oxide layer (must be linked to reactivity) / doesn't corrode